Table D-1

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1	Sample Size Method 2	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	VSP calculated quantity of samples: Δ = 50% of benchmark [2]			
AOC-1: Surface Soil										
1,2,4-Trimethylbenzene	41	5.21E+01	3.20E-03	9.38E-04	5.90E-04	2	2	yes	None	
Acetone	41	5.42E+03	9.63E-02	8.19E-03	1.53E-02	2	2	yes	None	
Aluminum	41	6.52E+03	2.54E+04	5.73E+03	5.18E+03	365	23	no	None	
Arsenic	41	3.90E-01	3.10E+00	1.25E+00	8.99E-01	11	184	no	None	
Barium	41	7.84E+03	1.25E+03	1.28E+02	2.35E+02	2	2	yes	None	
Benzo(a)anthracene	41	1.48E-01	3.97E+00	2.45E-01	6.86E-01	429	741	no	14	1
Benzo(a)pyrene	41	1.48E-02	7.75E-01	1.12E-01	1.80E-01	31	5087	yes	None	
Benzo(b)fluoranthene	41	1.48E-01	1.03E+00	1.35E-01	2.00E-01	2088	65	no	14	1
Beryllium	41	3.76E+01	8.90E-01	1.98E-01	1.80E-01	2	2	yes	None	
bis(2-Ethylhexyl)phthalate	39	3.47E+01	5.50E-01	1.43E-01	1.71E-01	2	2	yes	None	
Cadmium	41	3.90E+01	1.10E+00	1.06E-01	1.81E-01	2	2	yes	None	
Chromium	41	2.11E+02	1.49E+01	4.98E+00	3.53E+00	2	2	yes	None	
Chromium - Hexavalent	41	3.01E+01	3.10E+00	7.99E-01	4.99E-01	2	2	yes	None	
Chrysene	41	1.48E+01	4.12E+01	1.33E+00	6.55E+00	4	9	yes	None	
Cobalt	41	9.03E+02	4.60E+00	1.29E+00	9.99E-01	2	2	yes	None	
Copper	41	5.48E+02	2.35E+01	4.11E+00	4.01E+00	2	2	yes	None	
Isopropylbenzene	41	3.71E+02	2.27E-02	1.57E-03	3.57E-03	2	2	yes	None	
Lead	41	4.00E+02	8.07E+01	1.43E+01	1.79E+01	2	2	yes	None	
Manganese	41	3.24E+03	2.10E+02	7.85E+01	5.58E+01	2	2	yes	None	
Mercury	41	2.09E+00	7.40E-01	3.15E-02	1.14E-01	2	2	yes	None	
Methylene chloride	41	1.26E+00	2.35E-02	4.31E-03	4.92E-03	2	2	yes	None	
Nickel	41	8.32E+02	9.30E+00	2.54E+00	2.09E+00	2	2	yes	None	
Phenanthrene	41	1.71E+03	2.06E+00	1.56E-01	3.41E-01	2	2	yes	None	
Pyrene	41	1.70E+03	1.58E+00	1.73E-01	2.81E-01	2	2	yes	None	
Toluene	41	5.21E+02	4.40E-03	9.74E-04	7.48E-04	2	2	yes	None	
Vanadium	41	2.91E+02	2.93E+01	7.64E+00	6.38E+00	2	2	yes	None	
Xylene (total)	41	2.14E+02	7.70E-03	2.89E-03	1.36E-03	2	2	yes	None	
Zinc	41	9.92E+03	2.32E+02	4.66E+01	4.66E+01	2	2	yes	None	
AOC-1:Surface Soil number of additional samples needed for Human Health Risk Evaluation									14	

Table D-1

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-1: Subsurface Soil										
1,2,4-Trimethylbenzene	41	5.21E+01	1.40E-01	6.08E-03	2.47E-02	2	2	yes	None	
Acetone	41	5.42E+03	2.49E-01	2.76E-02	4.12E-02	2	2	yes	None	
Aluminum	41	6.52E+03	1.38E+04	3.55E+03	3.36E+03	13	11	yes	None	
Arsenic	41	3.90E-01	2.20E+00	6.36E-01	5.84E-01	50	79	no	9	2
Barium	41	7.84E+03	9.87E+01	3.05E+01	2.53E+01	2	2	yes	None	
Beryllium	41	3.76E+01	4.20E-01	1.14E-01	1.02E-01	2	2	yes	None	
Carbon disulfide	41	7.21E+02	4.10E-03	1.01E-03	6.86E-04	2	2	yes	None	
Chromium	41	2.11E+02	1.50E+01	3.09E+00	2.69E+00	2	2	yes	None	
Chromium, Hexavalent	41	3.01E+01	1.60E+00	6.77E-01	2.49E-01	2	2	yes	None	
Cobalt	41	9.03E+02	1.90E+00	5.59E-01	4.99E-01	2	2	yes	None	
Copper	41	5.48E+02	5.90E+00	1.48E+00	1.26E+00	2	2	yes	None	
Diethyl phthalate	41	1.42E+03	3.10E-01	4.58E-02	5.08E-02	2	2	yes	None	
Lead	41	4.00E+02	2.60E+01	3.75E+00	3.96E+00	2	2	yes	None	
Manganese	41	3.24E+03	2.41E+02	4.28E+01	5.37E+01	2	2	yes	None	
Mercury	41	2.09E+00	5.90E-01	2.48E-02	9.18E-02	2	2	yes	None	
Methylene chloride	41	1.26E+00	9.99E-02	7.38E-03	1.59E-02	2	2	yes	None	
Nickel	41	8.32E+02	5.90E+00	1.33E+00	1.42E+00	2	2	yes	None	
Vanadium	41	2.91E+02	1.37E+01	3.96E+00	3.40E+00	2	2	yes	None	
Xylene (total)	41	2.14E+02	2.17E-02	3.14E-03	3.42E-03	2	2	yes	None	
Zinc	41	9.92E+03	2.48E+01	7.41E+00	5.99E+00	2	2	yes	None	
AOC-1:Subsurface Soil number of additional samples needed for Human Health Risk Evaluation									9	
Total AOC-1: Soil number of additional samples needed for Human Health Risk Evaluation									14	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold], *i.e. from beta to 1-alpha … Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation.*"

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - Two methods are used to calculate sample size: Method 1 is preferred because it provides the samples needed to determine a difference between the sample mean and the threshold. Sometimes the mean is very close to the threshold and the standard deviation is large so Method 1 returns unreasonable sizes. When this occurs, Method 2 results are examined as a backup. Method 2 provides the samples needed to detect a difference within 50% of the benchmark, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. **Benzo(b)fluoranthene:** the sample size equation indicates 14 additional samples are recommended (65-41 historical =14). The data appear extremely skewed, with only three values detected (7.3%). **Benzo(a)anthracene**: the sample size equation indicates that a large number of samples are recommended. The data appear extremely skewed, with only five values detected (12.8%). Concentrations of benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene are found in the same vicinity, as follows: J-03S, J-04S, J-09S, J-12S, and J-14S. Because the concentrations are found together, a judgement was made to collect 14 samples for benzo(a)anthracene based on the sample size needed for benzo(b)fluoranthene.

2. Arsenic: the sample size equation indicates nine samples are recommended (50-41=9). Arsenic is a naturally occurring metal and may not be different from background.

Table D-2

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-1: Surface Soil										
Arsenic	41	1.80E+01	3.10E+00	1.25E+00	8.99E-01	2	2	yes	None	
Barium	41	3.30E+02	1.25E+03	1.28E+02	2.35E+02	13	19	yes	None	
Beryllium	41	1.00E+01	5.50E-01	1.98E-01	1.80E-01	2	2	yes	None	
Chromium	41	3.20E+01	3.10E+00	4.98E+00	3.53E+00	2	2	yes	None	
Chrysene	41	4.00E-01	1.49E+01	1.33E+00	6.55E+00	7	2665	yes	None	
Cobalt	41	1.30E+01	4.60E+00	1.29E+00	9.99E-01	2	2	yes	None	
Copper	41	6.10E+01	2.35E+01	4.11E+00	4.01E+00	2	2	yes	None	
Lead	41	1.20E+02	8.07E+01	1.43E+01	1.79E+01	2	3	yes	None	
Manganese	41	5.00E+02	2.10E+02	7.85E+01	5.58E+01	2	2	yes	None	
Mercury	41	1.00E-01	7.40E-01	3.15E-02	1.14E-01	26	47	yes	None	
Nickel	41	3.00E+01	9.30E+00	2.54E+00	2.09E+00	2	2	yes	None	
Toluene	41	2.00E+02	4.40E-03	9.74E-04	7.48E-04	2	2	yes	None	
Vanadium	41	2.00E+00	2.93E+01	7.64E+00	6.38E+00	350	2	yes	None	1
Zinc	41	1.20E+02	2.32E+02	4.66E+01	4.66E+01	5	7	yes	None	
AOC-1:Surface Soil number of additional samples needed for Human Health Risk Evaluation									0	

Table D-2

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1	Sample Size Method 2	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	VSP calculated quantity of samples: Δ = 50% of benchmark [2]			
AOC-1: Subsurface Soil										
Arsenic	41	3.90E-01	2.20E+00	6.36E-01	5.84E-01	2	79	yes	None	
Barium	41	7.84E+03	9.87E+01	3.05E+01	2.53E+01	2	2	yes	None	
Beryllium	41	3.76E+01	4.20E-01	1.14E-01	1.02E-01	2	2	yes	None	
Chromium	41	2.11E+02	1.50E+01	3.09E+00	2.69E+00	10	2	yes	None	
Cobalt	41	9.03E+02	1.90E+00	5.59E-01	4.99E-01	2	2	yes	None	
Copper	41	5.48E+02	5.90E+00	1.48E+00	1.26E+00	2	2	yes	None	
Diethyl phthalate	41	1.42E+03	3.10E-01	4.58E-02	5.08E-02	2	2	yes	None	
Lead	41	4.00E+02	2.60E+01	3.75E+00	3.96E+00	2	2	yes	None	
Manganese	41	3.24E+03	2.41E+02	4.28E+01	5.37E+01	2	2	yes	None	
Mercury	41	2.09E+00	5.90E-01	2.48E-02	9.18E-02	15	2	yes	None	
Nickel	41	8.32E+02	5.90E+00	1.33E+00	1.42E+00	2	2	yes	None	
Vanadium	41	2.91E+02	1.37E+01	3.96E+00	3.40E+00	28	2	yes	None	
Zinc	41	9.92E+03	2.48E+01	7.41E+00	5.99E+00	2	2	yes	None	
AOC-1:Subsurface Soil number of additional samples needed for Human Health Risk Evaluation									0	
Total AOC-1: Soil number of additional samples needed for Human Health Risk Evaluation									**0**	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D = 50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold]*, i.e. from beta to 1-alpha … Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation."*

3 - Sstatistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples. In this case we are focusing on the number of samples

4 - Two methods are used to calculate sample size: Method 1 is preferred because it provides the samples needed to determine a difference between the sample mean and the threshold. Sometimes the mean is very close to the threshold and the standard deviation is large so Method 1 returns unreasonable sizes. When this occurs, Method 2 results are examined as a backup. Method 2 provides the samples needed to detect a difference within 50% of the benchmark, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. Vanadium: the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates that there are enough samples to detect a difference of 1/2 the benchmark. Current hypothesis tests show that the null hypothesis that the site is dirty could not be rejected (see VSP output). With a benchmark of 2 mg/kg and a max and mean of 29.3 mg/kg and 6.64 mg/kg, respectively, additional samples would not likely change the outcome. There is one statistical outlier and data are highly skewed as the median is 5.25 mg/kg, quite a bit lower than the mean. For this reason and the fact that Vanadium is a naturally occurring metal and may not be different from background, additional samples are not warranted.

Table D-3

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/l)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-1: Ground Water- Human Health										
1-Methylnaphthalene	20	1.71E+00	6.47E-02	5.34E-03	1.45E-02	2	2	yes	None	
Acetone	20	5.48E+00	8.90E-03	4.95E-03	2.27E-03	2	2	yes	None	
Aluminum	20	2.44E+00	4.28E+00	5.03E-01	9.76E-01	4	7	yes	None	
Arsenic	20	1.00E-02	4.37E-02	8.44E-03	1.03E-02	377	38	no	7	1
Barium	20	2.00E+00	5.57E-01	1.82E-01	1.40E-01	2	2	yes	None	
Benzene	20	5.00E-03	1.45E-02	1.12E-03	3.22E-03	8	16	yes	None	
bis(2-Ethylhexyl)phthalate	20	4.80E-03	6.63E-03	1.27E-03	1.36E-03	3	5	yes	None	
Cyclohexane	20	1.25E+01	3.23E-02	1.93E-03	7.15E-03	2	2	yes	None	
Ethylbenzene	20	7.00E-01	8.00E-03	1.06E-03	1.96E-03	2	2	yes	None	
Lead	20	1.50E-02	1.95E-02	3.76E-03	4.62E-03	3	5	yes	None	
Manganese	20	1.15E+00	4.12E+00	8.16E-01	9.84E-01	77	27	no	7	2
Naphthalene	20	6.20E-03	1.63E-01	1.17E-02	3.65E-02	375	1185	no	7	3
Nickel	20	4.89E-01	5.16E-02	5.20E-03	1.12E-02	2	2	yes	None	
Thallium	20	2.00E-03	6.70E-03	3.41E-03	1.81E-03	16	30	yes	None	
Vanadium	20	1.71E-01	1.67E-02	2.71E-03	4.35E-03	2	2	yes	None	
Zinc	20	7.33E+00	1.96E-01	3.20E-02	4.15E-02	2	2	yes	None	
AOC-1: Groundwater number of additional samples needed for Human Health Risk Evaluation									7	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D = 50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold]*, i.e. from beta to 1-alpha … Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation.* "

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. Arsenic the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller but still large number of samples to detect a difference of 1/2 the benchmark.   VSP indicates that the data appear nonnormal and the nonparameteric hypothesis test rejects the null hypothesis that Arsenic is greater than the benchmark and Arsenic is a naturally occurring metal and may not be different from background.   For these reasons judgement is used to propose additional samples. The additional samples proposed are 7, as indicated by VSP for Manganese.

2. Manganese: the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark.   VSP indicates that the data appear nonnormal and the nonparameteric hypothesis test rejects the null hypothesis that Manganese is greater than the benchmark and Manganese is a naturally occurring metal and may not be different from background. For these reasons the Method 2 sample size is proposed (27-20=7).

3. Naphthalene: the Method 1 sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller but still very large number of samples to detect a difference of 1/2 the benchmark. VSP indicates that the data appear nonnormal and the nonparameteric hypothesis test rejects the null hypothesis that Naphthalene is greater than the benchmark. For these reasons judgement is used to propose additional samples. The additional samples proposed are 7, as indicated by VSP for Manganese.

Table D-4

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-3: Surface Soil										
Aluminum	7	6.52E+03	6.02E+03	4.03E+03	1.31E+03	4	3	yes	None	
Arsenic	7	3.90E-01	1.31E+03	1.18E+00	5.94E-01	7	82	yes	None	
Barium	7	7.84E+03	6.30E+02	1.90E+02	2.10E+02	2	2	yes	None	
Beryllium	7	3.76E+01	2.40E-01	1.79E-01	5.66E-02	2	2	yes	None	
Chromium	7	2.11E+02	5.90E+00	4.04E+00	1.44E+00	2	2	yes	None	
Cobalt	7	9.03E+02	1.35E+00	9.80E-01	3.14E-01	2	2	yes	None	
Copper	7	5.48E+02	4.60E+00	3.56E+00	8.06E-01	2	2	yes	None	
Lead	7	4.00E+02	1.35E+01	6.67E+00	3.39E+00	2	2	yes	None	
Manganese	7	3.24E+03	2.26E+02	1.07E+02	5.56E+01	2	2	yes	None	
Mercury	7	2.09E+00	2.20E-02	1.19E-02	6.24E-03	2	2	yes	None	
Nickel	7	8.32E+02	2.50E+00	1.83E+00	6.07E-01	2	2	yes	None	
Vanadium	7	2.91E+02	8.40E+00	5.93E+00	1.76E+00	2	2	yes	None	
Zinc	7	9.92E+03	3.46E+02	1.18E+02	1.35E+02	2	2	yes	None	
AOC-3:Surface Soil number of additional samples needed for Human Health Risk Evaluation									0	

Table D-4

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1	Sample Size Method 2	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	VSP calculated quantity of samples: Δ = 50% of benchmark [2]			
AOC-3: Subsurface Soil										
Acetone	7	5.42E+03	8.04E-02	2.87E-02	2.44E-02	2	2	yes	None	
Aluminum	7	6.52E+03	4.60E+03	3.63E+03	7.77E+02	2	2	yes	None	
Arsenic	7	3.90E-01	2.40E+00	1.12E+00	6.41E-01	8	9	no	1	1
Barium	7	7.84E+03	2.09E+02	5.52E+01	6.88E+01	2	2	yes	None	
Beryllium	7	3.76E+01	2.00E-01	1.61E-01	3.86E-02	2	2	yes	None	
Chromium	7	2.11E+02	4.00E+00	3.29E+00	6.49E-01	2	2	yes	None	
Cobalt	7	9.03E+02	1.10E+00	8.46E-01	2.00E-01	2	2	yes	None	
Copper	7	5.48E+02	5.00E+00	2.44E+00	1.20E+00	2	2	yes	None	
Lead	7	4.00E+02	4.30E+00	2.99E+00	6.39E-01	2	2	yes	None	
Manganese	7	3.24E+03	1.14E+02	7.28E+01	3.62E+01	2	2	yes	None	
Mercury	7	2.09E+00	3.40E-02	1.37E-02	1.39E-02	2	2	yes	None	
Nickel	7	8.32E+02	2.30E+00	1.63E+00	4.03E-01	2	2	yes	None	
Toluene	7	5.21E+02	1.80E-03	1.29E-03	5.11E-04	2	2	yes	None	
Vanadium	7	2.91E+02	7.90E+00	5.33E+00	1.21E+00	2	2	yes	None	
Zinc	7	9.92E+03	3.58E+01	1.66E+01	9.15E+00	2	2	yes	None	
AOC-3:Subsurface Soil number of additional samples needed for Human Health Risk Evaluation									1	
Total AOC-3: Soil number of additional samples needed for Human Health Risk Evaluation									1	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold]*, i.e. from beta to 1-alpha … Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation.* "

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. **Arsenic:** VSP recommends one additional sample to detect a difference between the mean of the site and background in the subsurface soil (8-7=1). Arsenic is a naturally occurring metal and may not be different from background.

Table D-5

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Ecological Risk Evaluation

| Constituent | Quantity of Phase I samples | Concentration (mg/kg) | | | | Sample Size Method 1 | Sample Size Method 2 | Statistical Power? [3] | Proposed quanity of additional samples to collect[4] | Notes |
		Bench-mark	Max	Mean	St Dev	VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	VSP calculated quantity of samples: Δ = 50% of benchmark [2]			
AOC-3: Surface Soil										
Arsenic	7	1.80E+01	1.31E+03	1.18E+00	5.94E-01	2	2	yes	None	
Barium	7	3.30E+02	6.30E+02	1.90E+02	2.10E+02	21	16	no	14	1
Beryllium	7	1.00E+01	2.40E-01	1.79E-01	5.66E-02	2	2	yes	None	
Chromium	7	4.00E-01	5.90E+00	4.04E+00	1.44E+00	3	445	yes	None	
Cobalt	7	1.30E+01	1.35E+00	9.80E-01	3.14E-01	2	2	yes	None	
Copper	7	6.10E+01	4.60E+00	3.56E+00	8.06E-01	2	2	yes	None	
Lead	7	1.20E+02	1.35E+01	6.67E+00	3.39E+00	2	2	yes	None	
Manganese	7	5.00E+02	2.26E+02	1.07E+02	5.56E+01	2	2	yes	None	
Mercury	7	1.00E-01	2.20E-02	1.19E-02	6.24E-03	2	2	yes	None	
Nickel	7	3.00E+01	2.50E+00	1.83E+00	6.07E-01	2	2	yes	None	
Vanadium	7	2.00E+00	8.40E+00	5.93E+00	1.76E+00	4	28	yes	None	
Zinc	7	1.20E+02	3.46E+02	1.18E+02	1.35E+02	34926	45	no	14	2
AOC-3:Surface Soil number of additional samples needed for Ecological Risk Evaluation									14	

Table D-5
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-3: Subsurface Soil										
Arsenic	7	1.80E+01	2.40E+00	1.12E+00	6.41E-01	2	2	yes	None	
Barium	7	3.30E+02	2.09E+02	5.52E+01	6.88E+01	2	3	yes	None	
Beryllium	7	1.00E+01	2.00E-01	1.61E-01	3.86E-02	2	2	yes	None	
Chromium	7	4.00E-01	4.00E+00	3.29E+00	6.49E-01	2	92	yes	None	
Cobalt	7	1.30E+01	1.10E+00	8.46E-01	2.00E-01	2	2	yes	None	
Copper	7	6.10E+01	5.00E+00	2.44E+00	1.20E+00	2	2	yes	None	
Lead	7	1.20E+02	4.30E+00	2.99E+00	6.39E-01	2	2	yes	None	
Manganese	7	5.00E+02	1.14E+02	7.28E+01	3.62E+01	2	2	yes	None	
Mercury	7	1.00E-01	3.40E-02	1.37E-02	1.39E-02	2	3	yes	None	
Nickel	7	3.00E+01	2.30E+00	1.63E+00	4.03E-01	2	2	yes	None	
Toluene	7	2.00E+02	1.80E-03	1.29E-03	5.11E-04	2	2	yes	None	
Vanadium	7	2.00E+00	7.90E+00	5.33E+00	1.21E+00	3	14	yes	None	
Zinc	7	1.20E+02	3.58E+01	1.66E+01	9.15E+00	2	2	yes	None	
AOC-3: Subsurface Soil number of additional samples needed for Ecological Risk Evaluation									0	
Total AOC-3: Soil number of additional samples needed for Ecological Risk Evaluation									**14**	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold]*, i.e. from beta to 1-alpha … Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation.*"

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. **Barium** VSP recommends 14 additional sample to detect a difference between the mean of the site and background in the subsurface soil (21-7=14). Barium is a naturally occurring metal and may not be different from background.

2. **Zinc**: the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark. The Method 2 number still seems too high given that the current hypothesis tests show that the null hypothesis that the site is dirty could not be rejected (see VSP output), additional samples would not likely change the outcome. For this reason and the fact that Zinc is a naturally occurring metal and may not be different from background, additional samples equal to those recommended for Barium are proposed.

Table D-6

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health and Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Bench-mark	Concentration (mg/l)			Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
			Max	Mean	St Dev					
AOC-3: Surface Water- Human Health										
Antimony	7	6.40E-01	4.20E-03	2.96E-03	1.25E-03	2	2	yes	None	
Chromium - Hexavalent	7	2.22E+00	1.60E-02	6.86E-03	6.12E-03	2	2	yes	None	
Lead	7	1.69E-02	1.02E-02	4.46E-03	2.87E-03	2	2	yes	None	
Manganese	7	1.00E-01	1.94E-01	5.85E-02	7.90E-02	33	23	no	16	1
Zinc	7	2.60E+01	7.58E-02	2.98E-02	2.07E-02	2	2	yes	None	
		AOC-3: Surface water number of additional samples needed for Human Health Risk Evaluation							16	
AOC-3: Surface Water- Ecological										
Barium	7	2.50E+01	7.68E-01	4.77E-01	2.43E-01	2	2	yes	None	
Chromium - Hexavalent	7	4.96E-02	1.60E-02	6.86E-03	6.12E-03	2	2	yes	None	
Lead	7	5.30E-03	1.02E-02	4.46E-03	2.87E-03	103	12	no	5	2
Zinc	7	8.42E-02	7.58E-02	2.98E-02	2.07E-02	3	4	yes	None	
		AOC-3:Surface water number of additional samples needed for Ecological Risk Evaluation							5	
Total AOC-3: Surface water of additional samples needed for Human Health and Ecological Risk Evaluation									**16**	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold]*, i.e. from beta to 1-alpha… Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation.*"

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. Manganese: the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark.   For this reason and the fact that Manganese is a naturally occurring metal and may not be different from background, the Method 2 sample size is proposed (23-7=16).

2. Lead: the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark.   For this reason and the fact that Lead is a naturally occurring metal and may not be different from background, the Method 2 sample size is proposed (12-7=5).

Table D-7
Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health and Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-3: Sediment- Human Health										
1,2,4-Trimethylbenzene	44	3.70E+04	4.90E-03	1.03E-03	9.03E-04	2	2	yes	None	
Acetone	44	6.60E+05	6.68E-01	5.61E-02	1.08E-01	2	2	yes	None	
Aluminum	44	1.50E+05	3.59E+04	6.67E+03	8.08E+03	2	2	yes	None	
Arsenic	44	1.10E+02	1.73E+01	2.53E+00	2.99E+00	2	2	yes	None	
Barium	44	2.30E+04	1.70E+03	1.89E+02	3.03E+02	2	2	yes	None	
Beryllium	44	2.70E+01	1.40E+00	2.72E-01	3.07E-01	2	2	yes	None	
bis(2-Ethylhexyl)phthalate	44	2.40E+02	7.29E-01	1.03E-01	1.33E-01	2	2	yes	None	
Cadmium	44	1.10E+03	6.70E-01	1.20E-01	1.34E-01	2	2	yes	None	
Carbon disulfide	44	7.30E+04	2.41E-02	2.53E-03	4.43E-03	2	2	yes	None	
Chromium	44	3.60E+04	2.99E+01	6.35E+00	7.12E+00	2	2	yes	None	
Cobalt	44	3.20E+04	1.04E+01	1.76E+00	2.15E+00	2	2	yes	None	
Copper	44	2.10E+04	5.71E+01	7.55E+00	1.08E+01	2	2	yes	None	
Hexane	44	4.40E+04	8.60E-03	1.35E-03	1.54E-03	2	2	yes	None	
Lead	44	5.00E+02	3.41E+01	8.56E+00	7.71E+00	2	2	yes	None	
Manganese	44	1.40E+04	5.88E+02	1.42E+02	1.47E+02	2	2	yes	None	
Mercury	44	3.40E+01	1.10E-01	1.55E-02	1.83E-02	2	2	yes	None	
Methyl ethyl ketone	44	4.40E+05	1.35E-01	1.10E-02	2.08E-02	2	2	yes	None	
Methylene chloride	44	7.30E+03	1.99E-02	5.05E-03	2.87E-03	2	2	yes	None	
Nickel	44	1.40E+03	2.35E+01	3.91E+00	4.87E+00	2	2	yes	None	
Selenium	44	2.70E+03	2.20E+00	2.95E-01	3.84E-01	2	2	yes	None	
Silver	44	3.50E+02	1.30E+00	1.31E-01	2.46E-01	2	2	yes	None	
Toluene	44	5.90E+04	3.76E-02	2.01E-03	5.57E-03	2	2	yes	None	
Vanadium	44	3.30E+02	5.89E+01	1.02E+01	1.23E+01	2	2	yes	None	
Zinc	44	7.60E+04	8.96E+02	1.69E+02	2.27E+02	2	2	yes	None	
AOC-3:Sediment number of additional samples needed for Human Health Risk Evaluation									0	

Table D-7

Calculated Minimum Sample Number to Estimate Exposure Point Concentrations for Human Health and Ecological Risk Evaluation

Constituent	Quantity of Phase I samples	Concentration (mg/kg)				Sample Size Method 1 VSP calculated quantity of samples: Δ=sample mean-benchmark [1]	Sample Size Method 2 VSP calculated quantity of samples: Δ = 50% of benchmark [2]	Statistical Power? [3]	Proposed quanity of additional samples to collect[4]	Notes
		Bench-mark	Max	Mean	St Dev					
AOC-3: Sediment- Ecological										
Arsenic	44	8.20E+00	1.73E+01	2.53E+00	2.99E+00	4	6	yes	None	
bis(2-Ethylhexyl)phthalate	44	1.82E-01	7.29E-01	1.03E-01	1.33E-01	26	20	yes	None	
Cadmium	44	1.20E+00	6.70E-01	1.20E-01	1.34E-01	2	2	yes	None	
Chromium	44	8.10E+01	2.99E+01	6.35E+00	7.12E+00	2	2	yes	None	
Copper	44	3.40E+01	5.71E+01	7.55E+00	1.08E+01	3	5	yes	None	
Lead	44	4.67E+01	3.41E+01	8.56E+00	7.71E+00	2	3	yes	None	
Mercury	44	1.50E-01	1.10E-01	1.55E-02	1.83E-02	2	2	yes	None	
Methylene chloride	44	3.82E+00	1.99E-02	5.05E-03	2.87E-03	2	2	yes	None	
Nickel	44	2.09E+01	2.35E+01	3.91E+00	4.87E+00	3	4	yes	None	
Silver	44	1.00E+00	1.30E+00	1.31E-01	2.46E-01	3	4	yes	None	
Toluene	44	9.40E-01	3.76E-02	2.01E-03	5.57E-03	2	2	yes	None	
Zinc	44	1.50E+02	8.96E+02	1.69E+02	2.27E+02	1262	80	no	None	1
AOC-3:Sediment number of additional samples needed for Ecological Risk Evaluation									0	
Total AOC-3: Sediment number of additional samples needed for Human Health and Ecological Risk Evaluation									0	

1 - D = the difference between the sample mean and the benchmark, page 107 – 108 of Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G4, February 2006, http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf

2 - D =50% of threshold chosen in accordance with VSP User Guide, Version 5.0, September 2007, page 3.7, "[Delta] *probabilities are 20% to 95%* [of threshold], *i.e. from beta to 1-alpha … Determining a reasonable value for the size of the gray region calls for professional judgment and cost/benefit evaluation.*"

3 - statistical power is achieved when either the null hypothesis is rejected or the sample size equation indicates a sample size less than the number of Phase I samples, in this case we are focusing on the number of samples

4 - the minimum number of samples between the two methods is used to indicate if samples are needed based on the specific chemical, the VSP recommended sample size is used or professional judgement, (see notes next column), when sampling is conducted for that chemical, other analyses will be run.

Notes:

1. Zinc: the Method 1sample size equation indicates a large number of samples are recommended to detect a difference between the mean of the site and the benchmark, while Method 2 indicates a smaller number of samples to detect a difference of 1/2 the benchmark. The Method 2 number still seems too high given that the current hypothesis tests show there is one statistical outlier skewing the parameteric sample size test and that the null hypothesis that the site is dirty could be rejected using the nonparametric test (see VSP output), additional samples would not likely change the outcome. For this reason and the fact that Zinc is a naturally occurring metal and may not be different from background, additional samples are not proposed.

Area: Process Area

X Coord	Y Coord	Label	Value	Type	Historical
-12081.7249	-4725.6866			Systematic	T
-11855.4289	-4725.6866			Systematic	T
-11629.1329	-4725.6866			Systematic	T
-11402.8369	-4725.6866			Systematic	T
-11176.5409	-4725.6866			Systematic	T
-10950.2448	-4725.6866			Systematic	T
-11742.2809	-4529.7085			Systematic	T
-11515.9849	-4529.7085			Systematic	T
-11289.6889	-4529.7085			Systematic	T
-11063.3928	-4529.7085			Systematic	T
-10837.0968	-4529.7085			Systematic	T
-10610.8008	-4529.7085			Systematic	T
-12308.0209	-4333.7304			Systematic	T
-11629.1329	-4333.7304			Systematic	T
-11402.8369	-4333.7304			Systematic	T
-11176.5409	-4333.7304			Systematic	T
-10950.2448	-4333.7304			Systematic	T
-10723.9488	-4333.7304			Systematic	T
-11742.2809	-4137.7523			Systematic	T
-11515.9849	-4137.7523			Systematic	T
-11289.6889	-4137.7523			Systematic	T
-11063.3928	-4137.7523			Systematic	T
-10837.0968	-4137.7523			Systematic	T
-10610.8008	-4137.7523			Systematic	T
-11289.6889	-3745.7961			Systematic	T
-11063.3928	-3745.7961			Systematic	T
-10837.0968	-3745.7961			Systematic	T
-10610.8008	-3745.7961			Systematic	T
-10045.0608	-3549.8180			Systematic	T
-9818.7647	-3549.8180			Systematic	T
-10384.5048	-3353.8399			Systematic	T
-10158.2088	-3353.8399			Systematic	T
-9931.9127	-3353.8399			Systematic	T
-10497.6528	-3157.8618			Systematic	T
-10271.3568	-3157.8618			Systematic	T
-10045.0608	-3157.8618			Systematic	T
-9818.7647	-3157.8618			Systematic	T
-10384.5048	-2961.8837			Systematic	T
-10158.2088	-2961.8837			Systematic	
-9931.9127	-2961.8837			Systematic	T
-11396.6618	-4527.3575			Manual	T
-10167.6862	-3057.9302			Manual	T
-10766.1439	-4757.1225			Manual	T

Area: North Residential Area

X Coord	Y Coord	Label	Value	Type	Historical
-10578.8784	-3104.9925			Random	
-10580.0307	-2834.4477			Manual	

Area: South Residential

X Coord	Y Coord	Label	Value	Type	Historical

X Coord	Y Coord	Label	Value	Type	Historical
-10474.4019	-3973.0675			Manual	T
-10488.9231	-4176.3649			Manual	T
-10448.9897	-4150.9528			Manual	T

Area: Non-Process Area

X Coord	Y Coord	Label	Value	Type	Historical
-12332.8558	-4819.4931			Systematic	
-12545.6701	-4606.6789			Systematic	
-12332.8558	-4606.6789			Systematic	
-12120.0415	-4606.6789			Systematic	
-11907.2273	-4606.6789			Systematic	
-12545.6701	-4393.8646			Systematic	
-12332.8558	-4393.8646			Systematic	
-12120.0415	-4393.8646			Systematic	
-11907.2273	-4393.8646			Systematic	
-12545.6701	-4181.0503	Composite Samples		Systematic	
-12332.8558	-4181.0503			Systematic	
-12120.0415	-4181.0503			Systematic	
-11907.2273	-4181.0503			Systematic	
-12545.6701	-3968.2360			Systematic	
-12332.8558	-3968.2360			Systematic	
-12120.0415	-3968.2360			Systematic	
-11907.2273	-3968.2360			Systematic	
-11694.4130	-3968.2360			Systematic	
-11481.5987	-3968.2360			Systematic	
-11694.4130	-3755.4217			Systematic	
-11481.5987	-3755.4217			Systematic	

Area: Wetlands

X Coord	Y Coord	Label	Value	Type	Historical
-8765.3742	-6182.4949			Systematic	
-8300.3087	-6182.4949			Systematic	
-7835.2433	-6182.4949			Systematic	
-11788.2997	-5779.7364			Systematic	
-11323.2342	-5779.7364			Systematic	
-10858.1688	-5779.7364			Systematic	
-10393.1033	-5779.7364			Systematic	
-9928.0378	-5779.7364			Systematic	
-9462.9724	-5779.7364			Systematic	
-8997.9069	-5779.7364			Systematic	
-8532.8414	-5779.7364			Systematic	
-8067.7760	-5779.7364			Systematic	
-11555.7670	-5376.9779			Systematic	
-11090.7015	-5376.9779			Systematic	
-10625.6360	-5376.9779			Systematic	
-10160.5706	-5376.9779			Systematic	
-9695.5051	-5376.9779			Systematic	
-9230.4396	-5376.9779			Systematic	
-8765.3742	-5376.9779			Systematic	
-8300.3087	-5376.9779			Systematic	
-7835.2433	-5376.9779			Systematic	
-11788.2997	-4974.2194			Systematic	
-11323.2342	-4974.2194			Systematic	
-10858.1688	-4974.2194			Systematic	

X Coord	Y Coord	Label	Value	Type	Historical
-10393.1033	-4974.2194			Systematic	
-9928.0378	-4974.2194			Systematic	
-9462.9724	-4974.2194			Systematic	
-8997.9069	-4974.2194			Systematic	
-8532.8414	-4974.2194			Systematic	
-8067.7760	-4974.2194			Systematic	
-8765.3742	-4571.4609			Systematic	
-8300.3087	-4571.4609			Systematic	
-7835.2433	-4571.4609			Systematic	
-8997.9069	-4168.7024			Systematic	
-8532.8414	-4168.7024			Systematic	
-8067.7760	-4168.7024			Systematic	
-8788.1137	-5547.8481			Manual	
-8805.0014	-5654.8034			Manual	
-10234.8245	-5941.8938			Manual	
-9801.3742	-5941.8938			Manual	
-9401.6992	-5941.8938			Manual	

Area: Dock Samples

X Coord	Y Coord	Label	Value	Type	Historical
-9235.0330	-7048.2096			Manual	T
-9296.7660	-7090.7841			Manual	T
-9441.5193	-7128.0368			Manual	T
-9369.1427	-7186.5767			Manual	T
-9252.0628	-7147.1953			Manual	T

Area: Bay Samples

X Coord	Y Coord	Label	Value	Type	Historical
-9034.9329	-7122.7150			Manual	T
-9335.0831	-7232.3443			Manual	T
-9629.9115	-7332.3944			Manual	T

Area: Wastewater Pond

X Coord	Y Coord	Label	Value	Type	Historical
-10843.8941	-4894.9009			Manual	T
-10659.6104	-4898.2823			Manual	T